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The relationship between soundscapes and challenging behavior: A small-scale intervention study in a healthcare organization for individuals with severe or profound intellectual disabilities

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Abstract

This article evaluates the role of soundscapes in the emotional well-being of individuals with severe or profound intellectual disabilities. Given the high prevalence of visual disabilities in this group, they supposedly depend more on sound to understand their surroundings. Nevertheless, there is little attention for (the effects of) sound in long-term healthcare. To address this issue, we conducted a small-scale intervention study among 13 healthcare professionals with *Mobile Soundscape Appraisal and Recording Technology* (MoSART: a smartphone application). Pre- and post-test measurements were administered of the emotional well-being (measured as moods and challenging behavior) of 15 clients with intellectual disabilities. Results showed that the MoSART intervention was accompanied by an increased experience of vibrant soundscapes and audibility of human sounds as perceived by the professionals, and a significant decrease of negative moods and severity of stereotypical behavior in the clients.

Keywords

Soundscapes, sound, mood, challenging behavior, quality of life, disabilities, healthcare

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Introduction

Florence Nightingale[1] already understood and emphasized the deleterious effects of noise on both sick and well individuals in her seminal work "Notes on Nursing: What it is and What it is Not." However, with a strong focus on the visual domain in research, architecture, and healthcare, the focus on sound in research on quality of life, despite Nightingale's conclusions, seems to have diminished. Although there is a well-established body of research on the acute effects of noise,[2,3] there is little knowledge about the effects of sound in long-term healthcare settings. This holds in particular for special needs care, where the effects of unfavorable soundscapes could have considerable effects.

Special needs care fosters, among others, individuals with severe or profound intellectual disabilities. These individuals are characterized by prominent deficiencies in intellectual functions such as learning and problem-solving, as well as deficits in adaptive functioning, such as communication and social participation.[4,5] As a consequence of their severe disabilities, they are in need of pervasive support, making them dependent on others for all aspects of daily physical care, health, and safety[4,6] including the (interior) design of the environments they live in. Furthermore, these intellectual disabilities are often accompanied by sensory disabilities. The prevalence of visual disabilities, for example, increases with the severity of the intellectual disability, with an estimate of 70%–85% of individuals with a profound intellectual disability experiencing visual impairments.[7] Auditory impairments, although common, appear to be less prevalent, with estimates between 30% and 80%, in individuals with profound intellectual and multiple disabilities (PIMD).[8,9] Since auditory information can partially compensate a loss of visual information,[10,11] these individuals may be relatively more dependent on sounds in their environment to understand the world around them.

The combination of intellectual and visual disabilities can make the individual more vulnerable to developing behavioral problems and mental illness,[12] which is supported by findings showing that sensory problems are associated with the onset of challenging behavior.[13] Challenging behavior is defined by Emerson et al.[14] as culturally abnormal behavior of such intensity, frequency, and duration that the physical safety of the person or others is endangered, or behavior that is likely to lead to restrictions in the use of, or the denial of access to, communal facilities. Challenging behavior is common among individuals with severe of profound intellectual disabilities, with prevalence estimates of psychiatric and behavioral problems of 30%–50%,[15] entailing a three to five times higher risk of suffering from these problems compared to the general population.[13]

Healthcare professionals working closely with individuals with severe or profound intellectual disabilities (usually on a daily basis—also known as direct support professionals (DSP)) often report anecdotal evidence that highlights the importance of the sonic environment in relation to challenging behavior. Yet they also report that environmental sound is neither addressed in their professional training nor in team-meetings. Research confirms that healthcare professionals such as DSP often do not possess the necessary knowledge about the importance of the sonic environment.[8,9,16] As a consequence, it seems that DSP are often not consciously aware of the impact that sound has on the behavior of individuals with an intellectual disability and do not take it into account in their daily practice.[17]

Despite the indications of the importance of sound for individuals with severe or profound intellectual disabilities, there is little research on this topic[16,18]. To make a first step toward closing this knowledge gap, we conducted a small-scale intervention study working with both the DSP and the clients at a healthcare organization offering day care to individuals with intellectual disabilities. For this study, we choose to adopt the soundscape approach. A soundscape can be described as the sonic equivalent of a landscape.[19] It is a perceptual construct and consists of all the audible sounds

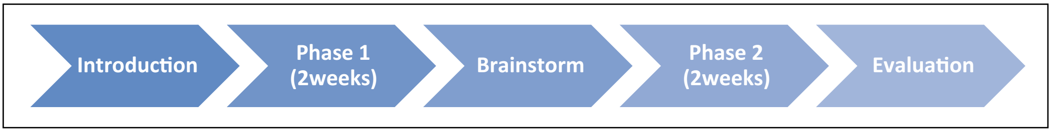

Figure 1. A depiction of the consecutive components of the MoSART intervention.

on any given moment (physical acoustic environment), as perceived or experienced by a person or people, in context. It thus includes the interrelationships between person and activity and place, in space and time.[20] This entails that one sonic environment (physically speaking) can elicit multiple soundscapes (or soundscape appraisals), depending on the perception of different (groups of) people. To measure and monitor these subjective experiences of soundscapes, a digital in situ experience sampling (or ecological momentary assessment) method was developed, called MoSART (Mobile Soundscape Appraisal and Recording Technology). The goal of the study was to examine the effects of the implementation of MoSART among DSP during a period of 4 weeks. It is hypothesized that by forcing DSP to consciously pay attention to the sounds in their environment, they will become more mindful of their influence on these sounds and as such, the perceived character of the soundscapes will improve (e.g. by reducing unwanted or unpredictable sounds), resulting in a reduction of challenging behavior in the individuals with severe or profound intellectual disabilities.

Method

Design

A small-scale non-randomized intervention study was performed, with pre- and post-test measurements. During a period of 4 weeks, the smartphone application MoSART was implemented among the participating DSP (see Figure 1). The dependent variables by which the effects of this intervention are expressed were the perceived soundscape characteristics as registered by the DSP with MoSART, and the moods and behavior of the participants with severe or profound intellectual disabilities which were registered with two questionnaires (see section “Instruments”).

Participants

DSP. The participating DSP ($N = 13$) were employed at a Dutch organization offering day care for individuals with severe or profound intellectual disabilities, at a location specialized in Intensive Support Groups, displaying significant challenging behavior. This group of DSP consisted of two male and 11 female participants with a mean age of 36.40 years ($SD = 9.96$, range = 22–53 years). All DSP received advanced healthcare-related vocational training, were long familiar with the clients, and all volunteered to participate in this study.

Clients. The group of participating clients consisted of 15 individuals (eight men, seven women) with a mean age of 43.33 years ($SD = 13.28$, range = 18–55 years). Following the classification of the diagnostic and statistical manual of mental disorders (DSM-V),[4] 13 participants were reported to have a severe intellectual disability and two participants were reported to have a profound intellectual disability. Based on the personal files, four participants were reported to have a severe visual disability, with visual acuity <0.3 Log-MAR (or so-called 20–40 vision, based on the criteria of the World Health Organization (WHO)).[21] Six participants reportedly had a moderate visual disability (<0.5 Log-Mar), and five participants were reported to have no visual disability. According to personal files, common challenging behaviors within this group were self-injury, (verbal) aggressive/destructive behavior, stereotypical behavior, and withdrawn behavior.

Ethical procedures have been followed and for all of the participants, written consent was obtained from their legal representatives, after they had been informed about the study via written information. Formal ethical approval to conduct this study was obtained by the institutional review board from the University of Groningen, consisting of the director of research of the faculty at the time the research proposal of the entire PhD project was reviewed.

Instruments

The MoSART intervention. MoSART is a smartphone application that allows participants to evaluate and monitor their soundscapes. It is based on the Swedish Soundscape-Quality Protocol as developed by Axelsson et al.[22] and contains similar questions. In addition, MoSART makes a short audio-recording of 30 seconds (which is not included in the analysis of this study).

In accordance with the Swedish Soundscape-Quality Protocol, MoSART asks the user (the DSP in this case) to assess their soundscape in terms of the most common soundscape descriptors: Pleasantness, Eventfulness, Calmness, and Vibrancy.[23] These descriptors are rated on a continuous rating scale, ranging 0 to 100. At the upper right end of the scale (score = 100), the name of the descriptor was prompted (Pleasant, Eventful, Calm, and Vibrant) and at the lower left end of the scale (score = 0) the opposite of the descriptor was prompted (Unpleasant, Uneventful, Chaotic, Boring). Furthermore, MoSART asks the user to assess the audibility of multiple classes of sound sources (Traffic, Mechanical, Human, Natural, and Other), and the overall quality of the respective acoustic and visual environment. All these questions are rated on a continuous rating scale with scores ranging from 0 to 100. A score of 0 indicated that a sound was not audible at all, and a score of 100 indicated that the sound was predominantly present. Similarly, a score of 0 reflected a poor overall quality of the environment, and a score of 100 a high overall quality. These assessments are gathered in a log within the application, so that the user is able to monitor their soundscape assessments.

In addition, MoSART included some extra questions and functionalities specifically for this study. To stimulate a constant flow of data, MoSART would send push notifications three times a day to the user (DSP), at random occasions during working hours, with the request to evaluate their soundscape. A snooze function was included to refuse or postpone the measurement when it was prompted at an inconvenient time. The remaining questions included two yes–no questions on the appropriateness (“Do you deem the soundscape appropriate for the clients?”) and changeability of the soundscape (“Are you able to change the soundscape yourself?”). These questions are included to study possible changes in perceived empowerment and mindfulness among the DSP.

The psychometric properties of MoSART are not yet known. However, despite that there are many different methods to collect soundscape data, questionnaires like the Swedish Soundscape-Quality Protocol, on which MoSART is based, have been used successfully and consistently in multiple soundscape studies.[23,24] The questionnaire was translated into Dutch, based on the work of Kangur[25] and Tijsma.[26] Furthermore, research by Mydlarz[27] indicates that mobile techniques have proven their suitability for use in research into soundscapes.

In this study, MoSART is used as part of an intervention meant to increase the mindfulness of the DSP regarding the sounds in their environment. This intervention consists of five components depicted in Figure 1. First, the researcher (first author) joined a team-meeting to inform the DSP about the study and the use of MoSART (Introduction). It was deliberately chosen to limit the training of the DSP in the use of MoSART to a short introduction and a test measurement, to capture spontaneous soundscape appraisal as opposed to trained soundscape appraisal to avoid observer bias. In the 2 weeks following, the DSP assessed their soundscapes with MoSART on a daily basis (Phase 1). Following this phase, a brainstorm-meeting was organized. During the brainstorm, preliminarily results from Phase 1 and the experiences of the DSP were discussed, for example which sounds stood out to them both positively and negatively. The goal of the brainstorm was to further increase the attention for and understanding of the sounds by the DSP in their environment. The brainstorm-meeting was led by the researcher and was attended by the same DSP as who used MoSART during Phase 1. The brainstorm-meeting also started the second phase of 2 weeks in which the DSP used MoSART on a daily basis (Phase 2). After Phase 2, the researcher visited the team one last time to evaluate the intervention and final results (Evaluation).

Prior to the beginning of the intervention, the DSP completed two questionnaires regarding the mood and behavior of the participating clients, serving as pre-test measurements (see sections below). After the evaluation-meeting, these questionnaires were administered again, serving as post-test measurements.

Mood, Interest and Pleasure Questionnaire. A Dutch translation of the Mood, Interest and Pleasure Questionnaire (MIPQ)[18,28] was used to measure the mood of the participating clients. This version of the MIPQ consists of 25 items (which are posed as questions), divided into three subscales (positive mood, negative mood, and interest) to measure the affect of adults with a severe intellectual disability. An example of an item is "How often during the last two weeks did you hear positive vocalizations when this client was involved in an activity?" The items are scored on a 5-point ordinal category scale (4 = always, 3 = often, 2 = half the time, 1 = sometimes, 0 = never). Higher scores indicate a better mood, and higher levels of interest and pleasure. An increase in the score on the scale negative mood reflects a decrease in the frequency of this behavior (and is thus also positive), since this scale is reversed in the calculation of the total score. The original MIPQ showed good reliability for all subscales and total score, with high internal consistency ($\alpha \geqslant .94$), high inter-rater ($r \geqslant .76$), and high test–retest reliability ($r \geqslant .87$) for the total scores. Research by Petry et al.[29] also showed good psychometric qualities for the Dutch translation of the MIPQ, with high internal consistency ($\alpha \geqslant .80$), high inter-rater ($r \geqslant .69$), and high test–retest reliability ($r \geqslant .86$).

Behavior Problem Inventory for people with Profound Intellectual and Multiple Disabilities. Data regarding the severity and frequency of the challenging behavior of the clients were gathered with the Dutch translation of the Behavior Problem Inventory (BPI-01),[29,30] which was tailored for this specific target group and included extra items to measure withdrawn behavior (Behavior Problem Inventory for people with Profound Intellectual and Multiple Disabilities (BPI-PIMD)).[31] The BPI-PIMD is a behavioral assessment tool consisting of 58 items for self-injurious, stereotypic, aggressive/destructive, and withdrawn behavior in individuals with an intellectual disability and other developmental disabilities. An example of an item is "Avoiding eye contact/Looking away." The items are scored on frequency (never, 1 = monthly, 2 = weekly, 3 = daily, 4 = every hour) and severity (1 = limited impact, 2 = moderate impact, 3 = severe impact). Research showed that the original BPI as the Dutch translation (BPI-01) and the BPI-PIMD are valid and reliable instruments.[29–31]

Analysis

Data analysis concerned a comparison of the soundscape assessments between the first and second phase, to measure the possible effects of increased attention to the sonic environment. For this, the continuous variables of MoSART were compared with each other across phases by means of paired sample *t*-tests. Due to uneven numbers of repeated measures across participants across the first and

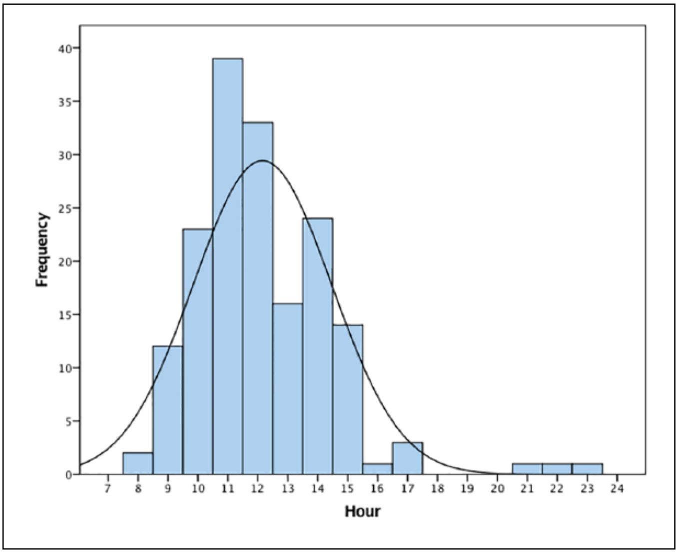

Figure 2. A histogram of the distribution of the number of measurements made by the DSP with MoSART as a function of time of day.

second phase, resulting in missing data, mean values on each continuous variable were calculated per participant per phase. With these calculated mean values, the dependent sample *t*-tests were performed. In order to assess the effects of the intervention on the behavior of the participating clients, paired samples *t*-tests were performed to analyze any differences in de pre- and post-test measurements of the MIPQ and BPI-PIMD.

Results

MoSART

A total of 170 measurements were made with MoSART by the 13 DSP, of which 74 in the first phase and 96 in the second phase. This number is lower than the anticipated number of measurement, due to part-time employment and prioritisation care tasks over the use of MoSART (i.e. sometimes it was impossible to make a measurement because the clients required support from the DSP). To analyze the participation degree of the DSP, a histogram was made of the number of measurements as a function of time of day. In Figure 2, it can be seen that most measurements were made between 08:00 and 18:00. No measurements were made before 08:00, between 18:00 and 21:00, and after 24:00.

Table 1 shows the results of the continuous variables of the soundscape assessments made by the DSP through the use of MoSART. For the soundscape descriptors, an increase in assessed Pleasantness, Eventfulness, and Vibrancy is visible, against a decrease of assessed Calmness between the first and second phase. A paired samples *t*-test was conducted to statistically compare these assessments and showed a significant increase in the assessments of the descriptor Vibrancy during the first (M=44.56, SD=7.22) and second (M=53.83, SD=12.71) phase ($t(7)=-3.02$, $p=.019$).

The results in Table 1 also indicate the presence of different types of sound sources. A decrease in Traffic sounds (e.g. cars passing), Natural sounds (e.g. song of birds), Mechanical sounds (e.g. household appliances), and Other sound sources seems to have made place for a significant increase

Table 1. Outcomes of the paired samples *t*-test for the soundscape characteristics as gathered by the DSP through MoSART during the first and second phase of the intervention.

Variables	*M* (*SD*)		Paired samples statistics						
	Phase 1	Phase 2	*M*	*SE*	95% Confidence interval of the difference		*t*	*df*	*p*
					Lower	Upper			
Pleasantness	59.00 (12.29)	63.20 (17.83)	3.20	4.50	−13.83	7.43	−.71	7	.500
Calmness	59.45 (12.54)	51.42 (10.67)	−8.04	3.70	−.72	16.80	2.17	7	.067
Eventfulness	53.27 (16.11)	61.89 (15.02)	8.63	6.41	−23.78	6.53	−1.35	7	.220
Vibrancy	44.56 (7.22)	53.83 (12.71)	9.27	3.07	−16.52	−2.02	−3.02	7	.019*
Traffic sounds	16.64 (15.00)	7.19 (7.18)	−9.44	4.65	−1.54	20.42	2.03	7	.082
Mechanical sounds	17.24 (14.41)	11.85 (13.69)	−5.39	5.51	−7.65	18.43	.98	7	.361
Human sounds	57.62 (11.90)	73.07 (13.73)	15.45	3.26	−23.16	−7.75	−4.74	7	.002*
Natural sounds	33.48 (14.40)	26.18 (21.52)	−7.30	7.62	−10.72	25.33	.96	7	.370
Other sounds	39.51 (11.72)	27.18 (23.04)	−12.33	8.84	−8.57	33.23	1.40	7	.206
Sound score	55.65 (8.13)	54.65 (17.32)	−1.00	5.48	−11.96	13.97	.18	7	.860
Visual score	55.67 (7.31)	58.21 (18.04)	2.54	5.62	−15.84	10.76	−.45	7	.665

DSP: direct support professional; MoSART: Mobile Soundscape Appraisal and Recording Technology.
*Significant $p < .05$.

in Human (e.g. speech) sounds ($t(7) = -4.74$, $p = .002$). The most frequent Other sound source was music or television (27 mentions out of 37).

Table 2 shows the results of the questions “Do you deem the soundscape appropriate for the clients?” and “Are you able the change something about the soundscape yourself?” The results suggest an increase of the number of times these questions were answered positively. Due to an uneven number of observations across participants across the first and second phase, it was ill-advised to perform any statistical analysis (e.g. a McNemar test) on these measures.

MIPQ

A paired samples *t*-test was conducted to compare the results of the MIPQ, before and after the use of MoSART by the participating DSP. Although there was an increase in the mean scores on all scales, a significant difference was only found between the pre-test ($M = 19.50$, $SD = 2.79$) and post-test ($M = 21.79$, $SD = 3.59$) measurements of negative moods, $t(14) = 2.56$, $p = .024$ (see Table 3). These results suggest a decrease of negative moods in clients with a severe or profound intellectual disability, since the Negative mood scale is inversed.

BPI-PIMD

To compare the frequency and severity of the challenging behavior of the participating clients before and after the use of MoSART by the participating DSP, a paired samples *t*-test was conducted (see Table 4). A significant difference was found between the pre-test ($M = 0.39$, $SD = 0.14$) and post-test ($M = 0.27$, $SD = 0.19$) measurements of the severity of stereotypical behavior,

Table 2. Frequency table indicating whether DSP deemed the soundscape appropriate for the time and place, and changeable.

		Appropriate		Changeable	
		Yes	No	Yes	No
Phase	First	65 (87.8%)	3 (4.1%)	30 (40.5%)	37 (50%)
	Second	87 (90.6%)	9 (9.4%)	57 (59.4%)	39 (40.6%)

DSP: direct support professional.
Due to missing data, the numbers do not always add up to 100%.

Table 3. Outcomes of the paired samples *t*-test between the pre- and post-test measurements of the moods from the clients as administered through the MIPQ before and after the MoSART intervention.

(sub)Scales	*M* (*SD*)		Paired samples statistics						
	Pre-test	Post-test	*M*	*SE*	95% Confidence interval of the difference		*t*	*df*	*p*
					Lower	Upper			
Total	50.29 (17.44)	56.64 (15.46)	6.36	3.83	−1.92	14.63	1.66	14	.121
Positive mood	17.60 (8.28)	20.00 (6.70)	2.40	1.58	–0.99	5.79	1.51	14	.152
Interest	13.64 (5.60)	15.29 (5.93)	1.64	1.30	−1.16	4.44	1.27	14	.227
Negative mood	19.50 (2.79)	21.79 (3.59)	2.29	0.89	0.36	4.21	2.56	14	.024*

MIPQ: Mood, Interest and Pleasure Questionnaire; MoSART: Mobile Soundscape Appraisal and Recording Technology.
*Significant $p < .05$.

$t(14) = -2.23$, $p = .042$. These results suggest a decrease of the severity of stereotypical behavior in clients with a severe or profound intellectual disability.

Discussion

This study aimed to evaluate the role of soundscapes and their characteristics in moods and the display of challenging behavior in individuals with severe or profound intellectual disabilities, through the implementation of the MoSART intervention. The results suggest a significant increase of the assessed vibrancy and the audibility of sounds indicative of humans. In addition, a significant decrease of negative moods and in the severity of stereotypical behavior among the participating clients with disabilities was reported. These findings are consistent with studies suggesting that sounds of humans add to the eventfulness of a soundscape[32] and the perceived audible safety.[33] We hypothesize that this increased audible safety had a positive effect on the emotional well-being of the clients. Furthermore, the findings are in line with studies suggesting that reduction of noise levels does not necessarily lead to more positive perceptions of that environment and might even lead to anxiety.[24,34–36] Results also indicate that during the second phase, the DSP more often felt they were able to change something about the soundscape themselves, even though they did not deem the soundscape more appropriate. This could reflect an increased sense of empowerment and

Table 4. Outcomes of the dependent paired *t*-test between the pre-test and post-test measurements of the frequency and severity of challenging behavior among the clients by the BPI-PIMD before and after the MoSART intervention, for the subscales Self-injurious behavior (SI), Stereotypical behavior (ST), Withdrawn behavior (WD), Aggressive–Destructive behavior (AD) and for the total frequency and severity of the challenging behaviors.

(sub)Scales	*M* (*SD*)		Paired samples statistics						
	Pre-test	Post-test	*M*	*SE*	95% Confidence interval of the difference		*t*	*df*	*p*
					Lower	Upper			
Frequency SI	.39 (.28)	.47 (.28)	.08	.05	–0.19	0.38	–1.45	14	.169
Severity SI	.28 (.20)	.25 (.16)	–.03	.04	–0.06	0.11	.71	14	.484
Frequency ST	.93 (.44)	.83 (.56)	–.10	.16	–0.24	0.45	.64	14	.530
Severity ST	.42 (.15)	.28 (.20)	–.13	.06	0.01	0.25	2.39	14	.031*
Frequency WD	1.13 (.66)	1.36 (.65)	.23	.18	–0.62	0.16	–1.26	14	.229
Severity WD	.60 (.27)	.58 (.29)	–.03	.07	–0.12	0.18	.36	14	.727
Frequency AD	.62 (.53)	.67 (.49)	.05	.08	–0.22	0.12	–.63	14	.539
Severity AD	.36 (.28)	.42 (.29)	.07	.09	–0.25	0.12	–.75	14	.466
Frequency Total	.73 (.29)	.75 (.32)	.02	.09	–0.21	0.17	–.18	14	.861
Severity Total	.39 (.14)	.33 (.15)	.06	.03	–0.02	0.13	1.61	14	.131

BPI-PIMD: Behavior Problem Inventory for people with Profound Intellectual and Multiple Disabilities.
*Significant $p < .05$.

mindfulness regarding their influence on the soundscape. Increased attention to the soundscape could be a mediating factor in this effect, but further research is needed to investigate this.

This small-scale intervention study appears to have yielded some positive effects; however, the generalizability of these results is subject to certain methodological limitations. Although questionnaires and protocols like the one included in MoSART are used very often in soundscape research, this was the first time MoSART as a tool was used in practice. Therefore, empirical research to validate this tool as a reliable assessment procedure seems like a logical and necessary next step. Generally, in situ administered questionnaires lead to high ecological validity, but a low experimental control and reproducibility,[23] as is the case in this study. Since the study was not set up as a randomized experiment with a control group, it is difficult to assign the positive effects to the intervention with certainty. Other limitations to this pilot study were that the number of participating DSP and clients was relatively small, the group of participating clients was highly heterogeneous, and the prioritisation of care tasks led to substantial missing data. Even though these limitations are quite common in studies concerning special needs individuals due to their unique disabilities and pervasive support needs, they do form a major concern in the validation of the results meaning that findings need to be interpreted cautiously as only indicative. Replication studies are necessary to confirm these results and gain further insight into the relation between soundscapes and human behavior and emotions.

To identify meaningful possible patterns in the missing data, we looked at the normal daily structures in residential healthcare organizations for people with severe intellectual disabilities. A day is typically divided into seven intervals: Morning, Morning activity, Lunch, Afternoon activity, Afternoon, Dinner, and Evening.[37] The data depicted in Figure 2 seem to indicate significant missing data during dinner and in the evening (before 08:00 and after 00:00 the clients are mostly asleep). This could be attributed to heightened workload during dinner, since all clients need individual attention during this interval, and less DSP being present during the evening interval. Even though previous research showed that time of day was not a significant predictor of staff attributions of the moods of people with profound intellectual disabilities,[38] further analysis of soundscape appraisal as function of time is advised.

Finally, one important methodological aspect that should be considered is the fact that the DSP were asked to assess the soundscape, instead of having the participating clients assess these environments, which is challenging if not impossible due to the cognitive impairments and diminished verbal capacities of these clients. These reasons also make it ill-advised to let the DSP make assumptions about how the clients experience their soundscapes. Therefore, we asked the DSP to assess the soundscape personally. It cannot be guaranteed that the assessment of the DSP is in accordance with the way the clients perceive soundscapes. However, similar approaches have been used in other soundscape studies performed in healthcare facilities.[24]

Despite its methodological limitations, this small-scale intervention study has showed that positive changes to soundscapes can occur within a short period of time and with relatively little effort. This demonstrates the immediate effects of soundscapes on the moods and behavior of individuals with a severe or profound intellectual disability, and plausibility of success of soundscape-related interventions. This knowledge is important because, as a result of methodological difficulties, there exists a lack of knowledge about the way individuals with a severe or profound intellectual disability express their feelings and preferences.[39] It is for example very difficult or even impossible to apply physiological or brain imaging techniques such as electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) to these individuals, since they would not understand what is going on, which questions ethical responsibility. Also, the staff working in facilities for individuals with an intellectual disability gradually builds up practical knowledge in recognizing and interpreting subtle behavioral signals. One difficulty is that this knowledge remains intuitive, fragmented, and sometimes unused, and is lost when individuals who know the clients disappear from their lives (e.g. because of staff turnover).[40] This is why the needs and preferences of individuals with a severe and profound intellectual disability often remain insufficiently known to those who are providing direct support, contributing to their already limited ability to communicate.[41] Poor sonic environments (e.g. loud music, unexpected sounds, or poor acoustics) make communication even more difficult, reinforcing the communicative limitations of individuals with a severe or profound intellectual disability and strengthening potential challenging behavior.[13] Of course, these limitations go both ways, affecting the staff as well. We know from studies performed in hospitals that noise negatively impacts staff on many levels, such as health and task performance.[42] We suspect these results also apply to special needs care.

Most people have control over their homes, and therefore, it can be assumed that these indoor soundscapes fit the needs and preferences of their residents. However, people with severe or profound intellectual disabilities often do not have this level of autonomy over their living environment and depend on the attentiveness, the knowledge, and skills of the DSP to fulfill their needs and wishes. This applies to other long-term healthcare settings as well, like retirement homes or long stay hospitals. For its vulnerable residents, these healthcare settings are their (temporary) living environments, so they should be able to feel at home. Unfortunately, these environments are often designed as very efficient workplaces, and not so much as pleasant environments to reside in. Therefore, it is important to identify the properties of sound that have a potential impact on the behavior of individuals with severe or profound intellectual disabilities, so that the daily practices and policies influencing their sonic environment can be adjusted accordingly. Furthermore, the main objective in these healthcare settings is to provide the best possible care to maintain and improve the well-being of its residents. As long as soundscapes continue to be overlooked, this objective will not be realized, because soundscapes have a significant influence on (physical and mental) well-being. As Florence Nightingale[1] said: "Unnecessary noise, then, is the most cruel absence of care which can be inflicted either on sick or well." Therefore, we should invest more in research on this topic and take careful notice of the design and maintenance of indoor soundscapes in long-term healthcare settings to ensure it is of the best possible quality.

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